Attorney Docket # 34250-20CPA

Serial No. 09/578,882
Amdt. dated March 24, 2004
Reply to Election Requirement dated February 25, 2004

Amendments to the Specification:

Please add the following new paragraph at page 13, before line 1:

a1

Figure 1 depicts a first preferred embodiment of the present invention 10, including a mosaic-type detector 11, a tunable filter with two states 12, and control electronics 13.

Please replace the paragraph at page 13, line 1, with the following amended paragraph:

a2

In the first preferred embodiment, one state 71 of [~~the~~] tunable filter 12 is nominally clear and has high transmission for all wavelengths of light, as shown in Figure 7. The other state 72 of [~~the~~] tunable filter 12 has a spectral filter action that is chosen to enable improved color imaging. Suitable filters are described in U.S. patent 5,892,612, "Tunable optical filter with white state", the contents of which are incorporated by reference. While only one embodiment of such a filter is described herein, any tunable filter of this or any other type would be suitable for the practice of the present invention.

Please replace the paragraph at page 13, line 8, with the following amended paragraph:

a3

A diagram of [~~such a~~] an exemplary tunable filter 12 is shown in Figure 6. It consists of the following elements in optical series: entrance polarizer 161 with its transmission axis 162 at 0°; fixed retarder 61 of retardance R with its fast axis 62 at 45°, variable retarder 63 that is switchable between substantially zero retardance and $\lambda/2$ retardance and has its slow axis 64 at 0° orientation; a second fixed retarder 67 of retardance R with its fast axis 68 at 45°; and exit polarizer 163 with its transmission axis 164 at 0°. When variable retarder 63 is a half-wave plate, fixed retarders 61 and 67 cancel, and the net result is a high transmission for all wavelengths of light. When variable retarder 63 exhibits low retardance, retarders 61 and 67 sum, and the effect is that of a single retarder with value 2R, oriented at 45°. This produces a spectrally varying transmission, as is understood by those familiar with the art.

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Please replace the paragraph at page 14, line 19, with the following amended paragraph:

a4

In the first preferred embodiment of the invention, the detector 11 is used with the filter 12 of FIG. 1, an implementation of which is shown in FIG. [~~Figure~~] 6, where retarders 61 and 67 are NRZ film from Nitto Denko with a retardance R=1λ at 440 nm. The optical transmission in the filtering state is high transmission at 440 nm, dropping until extinction is achieved at 545 nm, then increasing transmission with wavelength, up to the end of the visible range. This is shown in Figure 7 as 71 in the nominally clear state, and as curve 72 in the filtering state. The net transmission of the system (detector plus filter) is shown in FIG. [~~Figure~~] 10, for both the nominally clear and filtering states. The blue response is shown as 101 and 102, the green response as 103 and 104, and the red response as 105 and 106, respectively. These may be calculated as the product of the detector response shown in curves 31, 32, and 33, times the filter response shown as 71 and 72 for clear and filtering states, respectively.

Please add the following new paragraph at page 19, before line 10:

a5

FIG. 2 depicts a second preferred embodiment of the present invention 10', including a detector whose spectral response is varied by electronic means 21, a tunable filter with two states 12', and control electronics 13.

Please replace the paragraph at page 19, line 10, with the following amended paragraph:

a6

[~~A~~] In one implementation of the second preferred embodiment, tunable filter 12' consists of the same filter 12 as described above in reference to FIG. 6, used with a detector 21 comprising three CCD sensors and a trichroic prism, together with acquisition and color analysis electronics 13. Because a different sensor is used, this system will have a different set of spectral responses for both the filtered and unfiltered state, and one will need to recalculate the matrix M in the fashion described above, or some equivalent process.

Please replace the paragraph beginning at page 19, line 15, with the following amended paragraph:

a7

In yet another implementation of the second preferred embodiment, the detector 21 is a mosaic type, and incorporates circuitry to store two exposures for subsequent readout. This enables taking the two exposures in extremely rapid time-sequence, to essentially eliminate color blur.

Please replace the paragraph beginning at page 22, line 10, with the following amended paragraph:

a8

Another implementation of tunable filter 12' of the second preferred embodiment of the present invention solves both these problems. It utilizes a filter 12' with two states, neither of which is a clear state, in concert with the Silicon Vision detector. It is used to enhance the color differentiation of the detector, so the three images are more distinct in their spectral response, and to render the response more nearly a linear combination of the tristimulus curves. The filter is pictured in FIG. [~~Figure~~] 8. It consists of a retarder 61' oriented with its fast axis 62 at 45, having 2 retardance at 525 nm, in series with a TN cell 64' having its buffing axes 65' and 66' at 0 and 90, placed between parallel polarizers 161 and 163 having transmission axes 162 and 164 at 0. Such an assembly has high transmission at 525 nm, with minima at 450 and 650 nm, when the TN cell is driven; it has high transmission at 450 and 650 nm, and low transmission at 525, when the TN cell is undriven. These are shown as transmission curves 91 and 92 in FIG. [~~Figure~~] 9.

Please replace the paragraph beginning at page 24, line 16, with the following amended paragraph:

a9 cont

It is equivalent to place the filter between the detector and the scene, or between the source of illumination and the scene, as shown in FIG. 13. FIG. 13 shows an alternative embodiment 10" where the filter 12 (or 12') is placed between the source of illumination 141 and

a9 cond

the object to be imaged 142, rather than between the object and the detector. The former approach is more practical when imaging outdoor scenes and the like, where the illumination is not easily controlled; while the latter may be useful when the illumination comes from a single compact source. Placing the filter proximate to the illumination source rather than proximate to the detector is particularly apt when working with fiber optic illumination sources, for machine vision, inspection, medical imaging, endoscopy, and the like.